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Aggregations of Red-spotted Newts (*Notophthalmus viridescens viridescens* Rafinesque) in the Shenandoah Valley of Virginia

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Aggregations of red-spotted newt adults on land following pond drying have been mentioned by several authors. Healy (1970) observed aggregations of adults in mud along the margin of two ponds in Massachusetts. Gill (1978) found large numbers of adult newts in decaying logs and in vegetation clumps at the edges of several ponds that had dried completely on Shenandoah Mountain, Virginia, in 1977 but did not provide details on numbers of individuals or sex ratios. Mitchell & Buhlmann (1999) noted that red-spotted newts had been observed under logs and rocks around a sinkhole pond

that had dried. This note provides the details of those observations.

I found two aggregations of adult red-spotted newts around the edges of a vernal pond at the Shenandoah Valley sinkhole pond complex in the George Washington National Forest, 3.5 km WSW Sherando, Augusta County, Virginia, in two consecutive years. On 16 October 1997, I found adults in a 25 m diameter pool of shallow water in Pond 11 (see Buhlmann et al., 1999, for descriptions of these ponds and pond number designations). The adjacent pond (Pond 12, connected to

Pond 11 in wet periods) contained only a small, muddy pool about 3 x 4 m in size. Adult newts were found individually under rocks in the pond basin (5 occurrences) and in combinations of 3 (2 occurrences), 4 (3), 5 (3), and 8 (1). The decaying end of one log contained an intertwined mass of 47 individuals. This aggregation contained 19 males and 28 females. Average SVL for males was 41.3 ± 2.1 mm (39-46) and for females it was 39.3 ± 1.6 mm (35-42).

On 30 October 1998, I found adults in several aggregations around the interior margins of a completely dry Pond 11. I observed an aggregation of 42 newts in and under one log, 12 of which were in a cluster in the moist soil (8 males, 4 females). A second log (25 cm diameter, 2.1 m long, 5 m from the water's edge) near the small pool remaining in Pond 12 contained 34 adults in close aggregation (24 males, 10 females). Numbers of other adults under other logs in the interior margins of these two ponds were 3, 4, 5, 6, 7, 9, 12, and 43; one individual was under a rock. These were not in tight aggregations but scattered under the logs. Measurements of newts found in the smaller cluster in Pond 11 were: male mean = 42.1 ± 1.5 mm SVL (40-43, n = 8), female mean = 40.0 ± 2.2 mm SVL (37-43, n = 4). Males in the larger cluster in Pond 12 averaged 41.1 ± 2.7 mm SVL (35-46) and females averaged 37.8 ± 2.7 mm SVL (33-43). A 45 mm SVL male in this cluster was dead. Other species found under logs with the newts were *Ambystoma opacum* (1 adult), *Acris crepitans* (2 adults), and *Rana clamitans* (1 juvenile).

Another nearby pond (Pond 13) with a small pool of water on the dates noted above contained adult newts. None was found under logs or rocks around the dry rim. Unlike Pond 11, this pond rarely dries (Buhlmann et al., 1999), and I have observed newts in the water in this pond on numerous occasions in the winter.

Aggregation behavior in red-spotted newts apparently occurs in response to pond drying and to individuals seeking moist microhabitats to avoid desiccation and death. Pond drying was considered the cause of adult emigration from breeding ponds in the mountains of North Carolina (Huheey & Stupka, 1965). Adult *Notophthalmus viridescens dorsalis* endure episodes of pond drying in the North Carolina sandhills by burrowing beneath debris in pond basins (Morin, 1983). Gill (1978) noted, however, that adults migrate annually from high elevation ponds on Shenandoah Mountain (about 75 km N of the ponds in the Shenandoah Valley) in the fall and return in the spring. This may be in response to shallow ponds freezing completely to the bottom. The only year in which he found aggregations

was 1977, the year in which ponds dried completely. The ponds in the Valley do not freeze completely and adult newts have been observed in the water in several ponds during winter months (JCM, personal observations). Perhaps aggregation occurs only when ponds dry completely, thus stimulating adults to seek moist microhabitats and the company of other newts. Aggregations may be a function of adults seeking other individuals for behavioral or physiological benefits or the use of limited refugia where survivorship is enhanced. Aggregation in the latter case may simply be the consequence of finding the few moist refugia available during the dry period. Experimental tests would reveal the roles of ecological stimuli and individual behaviors in the aggregation behavior of red-spotted newts.

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